B. Calculation of C/[N+I] Due to Peak MSS Satellite Signal Power in the MAT Receiver

Equations 5 to 9 are applicable to the interfering signal path between the MSS satellite and the MAT receiver . It is assumed that the MSS and MAT signals have the same polarization, which is the worst-case coupling situation with regard to any MAT link.

$$D' = 42736.6[1 - 0.2951\{\cos(\zeta))(\cos(\beta)\}]^{0.5} \quad (5)$$

where:

D' = slant path distance (km) from the MSS satellite to the mobile earth station receiver.

$$E' = \cos^{-1}[\{(6378 + 35880)\sin(\cos^{-1}(\cos\zeta\cos B))\}/D] \quad (6)$$

where:

E' = elevation angle (degrees) from the Mat receiver to the MSS satellite.

$$A = \cos^{-1}[(\tan\zeta)\cot\{\cos^{-1}(\cos\zeta\cos\beta)\}] \quad (7)$$

where:

A = azimuth angle (degrees) from the MAT receiver to the MSS satellite.

$$C/[N+I] = C/N + 10 \log [N/\{N + 10^{-0.1(P_t' + G_t' + - 20 \log (D' \bullet f) - 32.45 + G_r')}\}] \quad (8)$$

where:

G_r' = gain of the MAT receiver antenna toward the MSS satellite (dBi).

The MAT receiver antenna patterns are given in Ref. 3 for antennas with diameters of 2.44 m and 10 m antenna. Due to apparent anomalies in the antenna gain equations and corresponding curves (Figure 1) in Ref. 3, an alternative equation was substituted for small off-axis angles (≤6.35° and ≤1.84° for the 2.44m and 10m antennas, respectively) and is given in Equation 9 below. Because the center of the Earth, MAT receiver, test aircraft, and MSS satellite are located in the same plane in Geometry 1 (see Section 3), the difference in elevation angles from the MAT receiver to the aircraft and to the satellite is the off-axis angle used to determine the MAT antenna gain G_r'.

$$G_r' = G_r - 2.5\times10^{-3}(d \bullet \theta/\lambda)^2 \quad (9)$$

where:

θ = MAT receiver antenna off-axis angle (degrees) toward the MSS satellite.

C. Availability Calculations for Desired Signals

Ref. 3 (Section 2.3) suggests that Rayleigh fading of the desired signal in a MAT link should be considered as a near-worst-case. This type of fading occurs in links subject to persistent blockage of the direct line-of-sight signal path, as could occur with use of a single antenna that is flush-mounted off the centerline of the fuselage of the test aircraft. Measured samples of fading statistics are presented in the form of MAT transmitter antenna gain statistics in Ref. 3 (Figure 3). This distribution indicates virtually 100% probability that a "gain" of 10 dBi will not be exceeded and the 0 dBi "gain" level is not exceeded for 96.86% of the time, which yields the following near-worst-case cumulative distribution of C/[N+I] assuming a constant interference level (or C/N in the absence of interference):

$$P(C/[N+I]) = 100\, e^{-3.46X} \tag{11}$$

$$X = 10^{(0.1\{C/[N+I] - C/[N+I]unfaded\})} \tag{12}$$

where:

P(C/[N+I]) = percentage of time that the C/[N+I] level is exceeded;

C/[N+I] = carrier to noise plus interference power ratio (dB) of interest;

$C/\{N+I]_{unfaded}$ = unfaded carrier to noise plus interference power` ratio (dB) calculated for the Geometry under consideration.

The inherent radio path availability is determined from the above cumulative distribution of fading by substituting the unfaded desired signal level (C/N from equation 3 plus N from equation 4) for C and substituting the minimum required signal level (minimum C/N from section 2, below, plus N from equation 4) for C_{th}. The classical "fade margin" (in dB) is defined as the unfaded C/N (Equation 3) C - 12 dB (the assumed performance threshold). Although Ref. 3 does not specify any interval of time over which availability should be addressed, it is assumed that there is a certain maximum time interval during which unacceptably low availability corresponds with "loss" of test data or triggers termination of testing. For analysis purposes, this time interval is taken to be ten consecutive seconds (i.e., typical interval for data communications).

It is noted in Ref. 3 that distributions corresponding to an exponent of ($-5C_{th}$) have been observed. In such a MAT link, larger fade margins than are indicated by equation 11 are needed to achieve a given availability . In the alternative, some MAT links may have signal paths that are not persistently blocked, such as in cases where a single antenna is mounted on the belly of the test aircraft near the centerline of the fuselage. In such cases, the signal fading is caused mainly by surface and atmospheric multipath, wherein the Earth surface or atmospheric strata scatters the transmitted signal toward the MAT receiver and these indirect signals add at various phase offsets to the direct line-of-sight (or slightly blocked) signal. This fading, referred to as Rician fading, becomes increasingly severe as the elevation angle from the MAT receiver antenna to the test aircraft is reduced. A certain percentage of the MAT links will exhibit Rician fading, but these are not addressed herein because Rayleigh fading is the worst case.

D. Variability of MSS Signals Due to Changes in MAT Receiver Antenna Discrimination

The two MAT operating scenarios (Geometries 1 and 2 which is defined in Section 3) occur for certain instants of time, and the calculated interference levels for those instants of time include the two worst-case local maxima over all time and test aircraft locations. Less interference will occur at all other instants of times (or aircraft locations). As shown in Table 3, the onset or falloff of interference from the peak value determined in Geometry 1 (maximum test aircraft range and worst-case MAT receiver antenna azimuth) is slow in relation to the assumed ten second intervals during which availability should be measured. Conversely, the onset or falloff of interference from the peak value determined in Geometry 2 (minimum test aircraft range and MAT receiver antenna pointed at MSS satellite) is fast in relation to the assumed ten second intervals during which availability should be measured.

Test Aircraft Velocity Relative to MAT Receiver	Change in 10 meter MAT Antenna Discrimination in 10 Sec.	
	Geometry 1	Geometry 2
300 km/hr, radially	0.05	6.2
300 km/hr, azimuthally	0.0	0.01
500 km/hr, radially	0.05	16.8
500 km/hr, azimuthally	0.0	0.02
700 km/hr, radially	0.05	21.3
700 km/hr, azimuthally	0.0	0.04
Note: The indicated changes in MAT antenna discrimination are the peak values occurring during any 10 second interval that start or end with the MAT receiver antenna pointing situation of Geometries 1 or 2.		

Ref. 3 does not provide details of aircraft operating areas that would enable rigorous evaluation of the statistics of interfering signal levels. However, Ref. 3 introduces an "S" parameter (Section 6), where S is the angular area centered on the MSS signal path over which the MAT receiver antenna is pointed during telemetry reception. The angular area S is applied in Ref. 3 under the assumption that the MAT receiver antenna and test aircraft flight patterns are oriented to enable direct pointing of the MAT receiver antenna at the MSS satellite (i.e., a worst-case situation). The angular area S' within which availability is measured is as follows:

$$S = \pi/4(\beta)(\Delta\alpha) \text{ steradians} \qquad (12)$$

$$\beta = 2\tan^{-1}[a/(d + a)] \text{ radians} \qquad (13)$$

$$\Delta\alpha = \tan^{-1}[(h/(d - a)) - (d - 2a)/2r] - \tan^{-1}[(h/d) - (d/2r)] \text{ radians} \qquad (14)$$

where:

S = angular area (steradians) centered on the MSS signal path over which the MAT receiver antenna is pointed during telemetry reception during normal testing;

β = elevation pointing span of MAT receiving antenna (radians);

$\Delta\alpha$ = azimuthal pointing span of MAT receiving antenna (radians);

h = maximum altitude (km) of test aircraft (20 km);

d = maximum great circle distance (km) to aircraft (320 km);

a = minimum radius (km) of flight patterns (20 km);

r = radius (km) of the Earth (6376 km).

The above calculations yield the following relationship between S and the angle of arrival α (radians) of the MSS signal (elevation above horizon of the MAT receiver antenna), over angles α that occur in this analysis:

$S = 1.557\alpha^{2.52}$, for $0.11217\ (6.43°) \leq \alpha \leq 1.09075\ (62.5°)$

$= 1.9380$, for $\alpha > 1.09075\ (62.5°)$

The ratio of angular areas S'/S relates to the probability of interfering signal power being less than a level I' that is associated with S', where S' is determined by an off-axis angle ϕ at the MAT receiving antenna toward the MSS satellite. That is, the interfering signal level I occurs at the off-axis angle ϕ. By setting ϕ equal to the angle where interference is at the level corresponding with the permissible level, the ratio S'/S yields the probability of exceeding the permissible level of interference. If this probability is less than the unavailability allocated to interference, the interference is considered to be acceptable.

E. Variability of MSS Downlink EIRP

The standard channel used in the system now under construction by AMSC alternately operates in digital in-band signaling, data, or voice modes using fixed frame formats. In relation to transmission statistics for voice or data, the transmission statistics for the in-band signaling mode are insignificant. In the voice mode, the CODEC generates frames that are transmitted only when speech is detected, and no transmission occurs at other times during normal speech or while the user is listening. In the voice mode, the probability of frame transmission in the downlink direction is about 0.35. In the data mode, a lengthy contiguous series of frames can be transmitted and there is a downlink transmission probability of about 0.5 when operating in this mode. There are about 80 MSS downlink transmission frames during the 10 sec. time interval of concern to MAT availability, and so, the Central Limit Theorem of statistics can be applied with respect to the three operating modes. Specifically, assuming an MSS channel has been assigned, there is a 0.35 probability of transmission for the MSS voice mode during small time intervals within the 10 sec. interval, and there is a 0.5 probability of transmission for the data mode during the entire 10 sec. interval. Only the latter statistic is considered in this study.

ATTACHMENT 2

SPREAD SHEET CALCULATIONS OF INTERFERENCE TO MAT

C/N+I Ratios w/ aeronautical telemetry @ max range and max altitude; same azimuth as MSS — Geometry 1 — 11-May-94

assumptions:

frequenc 1500 MHz

Longitud 101

												MSS Parameters					2.44 m Antenn, Max Gai 29			10 m Antenna, Max Gai 41.2			
Aeronautical Telemetry Parameters																							Delta Elev.
Longitud	Latitude	Altitude	Range	Distance	Elevatio	Azimuth	Pt	Gt	T	B	N	Pt'	Gt'	Distance	Elev	Azimuth	Gr	C/N	C/N+I	Gr	C/N	C/N+I	Angle
66.7	18.3	20	320.0	321.09	2.133	65.284	3	0	200	1.0E+06	**	3.5	32	37465.8	45.597	65.284	0.177	31.5	30.5	-5.953	43.7	43.4	43.464
72.8	40.9	20	320.0	321.09	2.1327	39.3155	3	0	200	1.0E+06	**	3.5	32	38306.5	34.637	39.316	3.331	31.5	29.8	-2.799	43.7	43.2	32.505
76	36.9	20	320.0	321.09	2.1327	37.8342	3	0	200	1.0E+06	**	3.5	32	37891.8	39.790	37.834	1.734	31.5	30.2	-4.396	43.7	43.3	37.658
76.4	38.3	20	320.0	321.09	2.1327	36.4536	3	0	200	1.0E+06	**	3.5	32	37971.5	38.767	36.454	2.033	31.5	30.2	-4.097	43.7	43.3	36.634
85.8	30.2	20	320.0	321.09	2.1327	28.3746	3	0	200	1.0E+06	**	3.5	32	37106.5	51.075	28.375	-0.901	31.5	30.7	-7.000	43.7	43.5	48.943
86.5	30.5	20	320.0	321.09	2.1327	27.0012	3	0	200	1.0E+06	**	3.5	32	37105.4	51.092	27.001	-0.901	31.5	30.7	-7.000	43.7	43.5	48.960
90.4	38.8	20	320.0	321.09	2.1327	16.6291	3	0	200	1.0E+06	**	3.5	32	37597.1	43.740	16.629	0.651	31.5	30.5	-5.479	43.7	43.4	41.608
106.4	33.2	20	320.0	321.09	2.1327	9.7946	3	0	200	1.0E+06	**	3.5	32	37113.6	50.959	9.795	-0.901	31.5	30.7	-7.000	43.7	43.5	48.826
113.2	41	20	320.0	321.09	2.1327	18.2399	3	0	200	1.0E+06	**	3.5	32	37799.9	40.993	18.240	1.392	31.5	30.3	-4.738	43.7	43.4	38.860
114.4	32.9	20	320.0	321.09	2.1327	23.6820	3	0	200	1.0E+06	**	3.5	32	37231.7	49.091	23.682	-0.663	31.5	30.7	-6.793	43.7	43.5	46.958
116.8	37.8	20	320.0	321.09	2.1327	24.7822	3	0	200	1.0E+06	**	3.5	32	37638.2	43.172	24.782	0.800	31.5	30.4	-5.330	43.7	43.4	41.040
117.5	36.8	20	320.0	321.09	2.1327	26.3121	3	0	200	1.0E+06	**	3.5	32	37584.8	43.912	26.312	0.606	31.5	30.5	-5.524	43.7	43.4	41.779
117.9	34.9	20	320.0	321.09	2.1327	27.9694	3	0	200	1.0E+06	**	3.5	32	37462.9	45.639	27.969	0.166	31.5	30.6	-5.964	43.7	43.4	43.507
119.1	34.1	20	320.0	321.09	2.1327	30.2420	3	0	200	1.0E+06	**	3.5	32	37445.9	45.884	30.242	0.105	31.5	30.6	-6.025	43.7	43.4	43.751
120	33.5	20	320.0	321.09	2.1327	31.9581	3	0	200	1.0E+06	**	3.5	32	37436.1	46.027	31.958	0.070	31.5	30.6	-6.060	43.7	43.4	43.894
120.4	34.6	20	320.0	321.09	2.1327	31.8057	3	0	200	1.0E+06	**	3.5	32	37522.7	44.783	31.806	0.382	31.5	30.5	-5.748	43.7	43.4	42.651
122.5	37.5	20	320.0	321.09	2.1327	32.9056	3	0	200	1.0E+06	**	3.5	32	37796.5	41.038	32.906	1.380	31.5	30.3	-4.750	43.7	43.4	38.906
159.7	22	20	320.0	321.09	2.1327	77.1690	3	0	200	1.0E+06	**	3.5	32	39582.8	20.680	77.169	9.423	31.5	27.0	3.293	43.7	42.1	18.547
72.8	40.9	20	320.0	321.09	2.1327	39.3155	3	0	200	1.0E+06	**	3.5	32	38306.5	34.637	39.316	3.331	31.5	29.8	-2.799	43.7	43.2	32.505
73.1	41.2	20	320.0	321.09	2.1327	38.7933	3	0	200	1.0E+06	**	3.5	32	38314.8	34.538	38.793	3.364	31.5	29.8	-2.766	43.7	43.2	32.406
75.3	39.9	20	320.0	321.09	2.1327	36.8802	3	0	200	1.0E+06	**	3.5	32	38129.2	36.790	36.880	2.635	31.5	30.0	-3.495	43.7	43.3	34.657
75.6	39.7	20	320.0	321.09	2.1327	36.6257	3	0	200	1.0E+06	**	3.5	32	38102.7	37.118	36.626	2.533	31.5	30.0	-3.597	43.7	43.3	34.985
79	35.1	20	320.0	321.09	2.1327	35.0937	3	0	200	1.0E+06	**	3.5	32	37650.5	43.003	35.094	0.845	31.5	30.4	-5.285	43.7	43.4	40.870
80.2	27.2	20	320.0	321.09	2.1327	39.7278	3	0	200	1.0E+06	**	3.5	32	37125.3	50.771	39.728	-0.901	31.5	30.7	-7.000	43.7	43.5	48.639
80.3	26.9	20	320.0	321.09	2.1327	39.8683	3	0	200	1.0E+06	**	3.5	32	37105.1	51.097	39.868	-0.901	31.5	30.7	-7.000	43.7	43.5	48.965
84	39.8	20	320.0	321.09	2.1327	25.5302	3	0	200	1.0E+06	**	3.5	32	37821.0	40.715	25.530	1.470	31.5	30.3	-4.660	43.7	43.4	38.582
84.5	33.9	20	320.0	321.09	2.1327	27.9724	3	0	200	1.0E+06	**	3.5	32	37382.9	46.805	27.972	-0.121	31.5	30.6	-6.251	43.7	43.5	44.672
84.9	44.6	20	320.0	321.09	2.1327	22.3462	3	0	200	1.0E+06	**	3.5	32	38179.9	36.167	22.346	2.832	31.5	29.9	-3.298	43.7	43.3	34.035
85.5	31.4	20	320.0	321.09	2.1327	28.0256	3	0	200	1.0E+06	**	3.5	32	37190.1	49.740	28.026	-0.812	31.5	30.7	-6.942	43.7	43.5	47.607
93.5	48.5	20	320.0	321.09	2.1327	9.9697	3	0	200	1.0E+06	**	3.5	32	38371.0	33.870	9.970	3.591	31.5	29.7	-2.539	43.7	43.2	31.737
93.5	45.5	20	320.0	321.09	2.1327	10.4580	3	0	200	1.0E+06	**	3.5	32	38103.5	37.108	10.458	2.536	31.5	30.0	-3.594	43.7	43.3	34.975

1. INTRODUCTION

1.1 Background

For over fifteen years, the 1435-1535 MHz band has been allocated in the US to the Mobile Aeronautical Telemetry (MAT) service. MAT involves transmissions from test aircraft through low gain antennas to receiving ground stations that use high-gain tracking antennas. The 1979 World Administrative Radio Conference (WARC-79) allocated the 1530-1535 MHz segment of the subject band to the maritime Mobile-Satellite Service (MSS) in the space-to-Earth direction on a shared basis with MAT, which is accommodated internationally under ITU Radio Regulation (RR) No. 723. Subsequently, this shared allocation was adopted in the US with a provision that the MAT allocation be reduced to secondary status in 1990 (US 78). NTIA studied this frequency sharing situation and recommended that MAT transmitters (e.g., test aircraft) located in coastal areas avoid using the same frequencies as maritime MSS downlinks in order to protect receiving ship earth stations (Ref. 1a).[1] Another NTIA study of sharing at 1530-1535 MHz between MSS downlinks and MAT systems concluded that "[a] signal from the maritime mobile-satellite is not strong enough to interfere with the telemetry receiver on earth" (Ref. 1b). However, that conclusion assumes MSS downlink Power Flux Density (PFD) levels of the order of -144 dBW/m^2/4 kHz, which are less than the levels that currently are achievable and desirable in domestic MSS systems.[2]

More recently, in US preparations for the 1992 WARC, MSS proponents evaluated the potential for sharing between MSS downlinks and MAT systems in the 1435-1530 MHz band. These studies concluded that sharing is feasible and that a 10 MHz or larger segment of that band would be among the most preferred new allocations for the MSS. Based on US and other proposals, WARC-92 allocated the 1525-1530 MHz band to MSS (space-to-Earth) on a worldwide basis. In addition, based on proposals from Canada and Brazil, WARC-92 allocated the 1492-1525 MHz for MSS (space-to-Earth) transmissions in the Americas (ITU Region 2). However, despite the demand for MSS in the US, the US declined to adopt the latter new MSS allocation (RR No. 722C).

After WARC-92, AMSC's interests in using these MSS allocations in the US were documented (Ref. 2) and distributed to certain MAT authorities in order to facilitate further discussions of the subject frequency sharing situation. In the time since WARC-92, however, MAT authorities have had to focus on the development of a coordination trigger for protection of

---

1 That NTIA study did not address potential interference from MAT systems to aircraft earth station operations that were (and remain) permissible in the 1525-1535 MHz band under RR Article 48. In addition, subsequent to the NTIA Report, the 1987 WARC for Mobile Telecommunications expanded the MSS allocations in the 1533-1535 MHz segment to include land MSS operations. Thus, all types of mobile earth stations could experience interference from MAT systems in the 1530-1535 MHz band. However, other studies have indicated that the means for preventing interference to MAT also would prevent interference to MSS.

2 The ship earth stations in operation at the time of the NTIA studies used antennas with diameters of 1.0 m to 1.2 m with gain levels greater than 20 dBi in the 1530-1535 MHz band. Earth stations for use on land, boats and aircraft are necessarily smaller and have substantially lower gain levels that require higher PFD levels.

93.7	32.5	20	320.0	321.09	2.1327	13.4101	3	0	200	1.0E+06	**	3.5	32	37088.2	51.373	13.410	-0.901	31.5	30.7	-7.000	43.7	43.5	49.240
95.9	36.2	20	320.0	321.09	2.1327	8.5931	3	0	200	1.0E+06	**	3.5	32	37325.7	47.657	8.593	-0.326	31.5	30.6	-6.456	43.7	43.5	45.525
97.3	37.6	20	320.0	321.09	2.1327	6.0500	3	0	200	1.0E+06	**	3.5	32	37420.3	46.256	6.050	0.013	31.5	30.6	-6.117	43.7	43.4	44.123
97.5	32.8	20	320.0	321.09	2.1327	6.4418	3	0	200	1.0E+06	**	3.5	32	37070.4	51.664	6.442	-0.901	31.5	30.7	-7.000	43.7	43.5	49.531
97.8	32.7	20	320.0	321.09	2.1327	5.9084	3	0	200	1.0E+06	**	3.5	32	37061.7	51.807	5.908	-0.901	31.5	30.7	-7.000	43.7	43.5	49.675
105.9	37.4	20	320.0	321.09	2.1327	8.0341	3	0	200	1.0E+06	**	3.5	32	37414.1	46.348	8.034	-0.009	31.5	30.6	-6.139	43.7	43.4	44.215
106.1	32.9	20	320.0	321.09	2.1327	9.3308	3	0	200	1.0E+06	**	3.5	32	37090.1	51.342	9.331	-0.901	31.5	30.7	-7.000	43.7	43.5	49.209
106.2	32.1	20	320.0	321.09	2.1327	9.7182	3	0	200	1.0E+06	**	3.5	32	37036.7	52.222	9.718	-0.901	31.5	30.7	-7.000	43.7	43.5	50.089
106.3	39.2	20	320.0	321.09	2.1327	8.3501	3	0	200	1.0E+06	**	3.5	32	37557.0	44.300	8.350	0.505	31.5	30.5	-5.625	43.7	43.4	42.168
106.5	48.4	20	320.0	321.09	2.1327	7.3372	3	0	200	1.0E+06	**	3.5	32	38343.5	34.196	7.337	3.480	31.5	29.7	-2.650	43.7	43.2	32.063
110.4	31.6	20	320.0	321.09	2.1327	17.5335	3	0	200	1.0E+06	**	3.5	32	37061.0	51.818	17.533	-0.901	31.5	30.7	-7.000	43.7	43.5	49.685
110.7	33.5	20	320.0	321.09	2.1327	17.2076	3	0	200	1.0E+06	**	3.5	32	37194.1	49.678	17.208	-0.798	31.5	30.7	-6.928	43.7	43.5	47.545
113.4	40.2	20	320.0	321.09	2.1327	18.8105	3	0	200	1.0E+06	**	3.5	32	37740.6	41.782	18.811	1.174	31.5	30.4	-4.956	43.7	43.4	39.649
114.6	32.5	20	320.0	321.09	2.1327	24.2402	3	0	200	1.0E+06	**	3.5	32	37210.1	49.426	24.240	-0.740	31.5	30.7	-6.870	43.7	43.5	47.294
115.1	39.3	20	320.0	321.09	2.1327	21.6320	3	0	200	1.0E+06	**	3.5	32	37708.1	42.219	21.632	1.055	31.5	30.4	-5.075	43.7	43.4	40.087
115.3	36.2	20	320.0	321.09	2.1327	23.3443	3	0	200	1.0E+06	**	3.5	32	37482.8	45.353	23.344	0.238	31.5	30.5	-5.892	43.7	43.4	43.220
117.2	32.8	20	320.0	321.09	2.1327	28.2054	3	0	200	1.0E+06	**	3.5	32	37300.9	48.030	28.205	-0.415	31.5	30.7	-6.545	43.7	43.5	45.898
117.3	33.1	20	320.0	321.09	2.1327	28.1677	3	0	200	1.0E+06	**	3.5	32	37323.7	47.688	28.168	-0.333	31.5	30.6	-6.463	43.7	43.5	45.555
118.2	35.1	20	320.0	321.09	2.1327	28.2956	3	0	200	1.0E+06	**	3.5	32	37485.7	45.312	28.296	0.248	31.5	30.5	-5.882	43.7	43.4	43.179
118.2	34.4	20	320.0	321.09	2.1327	28.7188	3	0	200	1.0E+06	**	3.5	32	37437.8	46.002	28.719	0.076	31.5	30.6	-6.054	43.7	43.4	43.869
118.2	33.8	20	320.0	321.09	2.1327	29.0938	3	0	200	1.0E+06	**	3.5	32	37397.4	46.592	29.094	-0.069	31.5	30.6	-6.199	43.7	43.5	44.459
118.3	33.9	20	320.0	321.09	2.1327	29.1806	3	0	200	1.0E+06	**	3.5	32	37407.2	46.448	29.181	-0.034	31.5	30.6	-6.164	43.7	43.4	44.315
118.4	34	20	320.0	321.09	2.1327	29.2670	3	0	200	1.0E+06	**	3.5	32	37417.0	46.305	29.267	0.001	31.5	30.6	-6.129	43.7	43.4	44.172
118.4	37.4	20	320.0	321.09	2.1327	27.2919	3	0	200	1.0E+06	**	3.5	32	37654.2	42.952	27.292	0.858	31.5	30.4	-5.272	43.7	43.4	40.820
120.1	34.6	20	320.0	321.09	2.1327	31.3756	3	0	200	1.0E+06	**	3.5	32	37512.5	44.928	31.376	0.345	31.5	30.5	-5.785	43.7	43.4	42.796
120.2	39.2	20	320.0	321.09	2.1327	28.8540	3	0	200	1.0E+06	**	3.5	32	37841.4	40.446	28.854	1.546	31.5	30.3	-4.584	43.7	43.4	38.314
121.2	37.4	20	320.0	321.09	2.1327	31.2061	3	0	200	1.0E+06	**	3.5	32	37743.6	41.741	31.206	1.185	31.5	30.3	-4.945	43.7	43.4	39.609
122.3	47.5	20	320.0	321.09	2.1327	27.8706	3	0	200	1.0E+06	**	3.5	32	38563.8	31.626	27.871	4.387	31.5	29.4	-1.743	43.7	43.1	29.494

C/N+I Ratios with Aero @ max altitude and same elevation angle as MSS   Geometry 2

Macro for receiver gain not used; max rcvr gain used

assumptions:

frequenc 1500 MHz

****

Aeronautical Telemetry Parameters											MSS Parameters (Longitud 101)						2.44 m Antenn (Max Gai 29)			10 m Antenna (Max Gai 41.2)			
Longitud	Latitude	Altitude	Distanc	Elevatio	Azimuth	Pt	Gt	T	B	N	Pt'	Gt'	Distance	Elev	Azimuth	Gr	C/N	C/N+I	Gr	C/N	C/N+I	Delta Ele Angle
66.7	18.3	20	27.952	45.597	65.284	3	0	200	1.0E+06	**	3.5	32	37465.8	45.5965	65.2836	29	52.7	30.0	41.2	64.9	30.0	0
72.8	40.9	20	35.073	34.637	39.316	3	0	200	1.0E+06	**	3.5	32	38306.5	34.6373	39.3155	29	50.7	28.2	41.2	62.9	28.3	0
76	36.9	20	31.181	39.790	37.834	3	0	200	1.0E+06	**	3.5	32	37891.8	39.7902	37.8342	29	51.7	29.2	41.2	63.9	29.2	0
76.4	38.3	20	31.864	38.767	36.454	3	0	200	1.0E+06	**	3.5	32	37971.5	38.7671	36.4536	29	51.6	29.0	41.2	63.8	29.0	0
85.8	30.2	20	25.682	51.075	28.375	3	0	200	1.0E+06	**	3.5	32	37106.5	51.0753	28.3746	29	53.4	30.7	41.2	65.6	30.7	
86.5	30.5	20	25.676	51.092	27.001	3	0	200	1.0E+06	**	3.5	32	37105.4	51.0923	27.0012	29	53.4	30.7	41.2	65.6	30.7	0
90.4	38.8	20	28.878	43.740	16.629	3	0	200	1.0E+06	**	3.5	32	37597.1	43.7403	16.6291	29	52.4	29.8	41.2	64.6	29.8	0
106.4	33.2	20	25.724	50.959	9.795	3	0	200	1.0E+06	**	3.5	32	37113.6	50.9591	9.79464	29	53.4	30.7	41.2	65.6	30.7	0
113.2	41	20	30.427	40.993	18.240	3	0	200	1.0E+06	**	3.5	32	37799.9	40.9925	18.2399	29	52.0	29.4	41.2	64.2	29.4	0
114.4	32.9	20	26.433	49.091	23.682	3	0	200	1.0E+06	**	3.5	32	37231.7	49.0905	23.682	29	53.2	30.5	41.2	65.4	30.5	0
116.8	37.8	20	29.180	43.172	24.782	3	0	200	1.0E+06	**	3.5	32	37638.2	43.1722	24.7822	29	52.3	29.7	41.2	64.5	29.7	0
117.5	36.8	20	28.789	43.912	26.312	3	0	200	1.0E+06	**	3.5	32	37584.8	43.9117	26.3121	29	52.4	29.8	41.2	64.6	29.8	0
117.9	34.9	20	27.932	45.639	27.969	3	0	200	1.0E+06	**	3.5	32	37462.9	45.6394	27.9694	29	52.7	30.0	41.2	64.9	30.0	0
119.1	34.1	20	27.817	45.884	30.242	3	0	200	1.0E+06	**	3.5	32	37445.9	45.8839	30.242	29	52.7	30.1	41.2	64.9	30.1	0
120	33.5	20	27.750	46.027	31.958	3	0	200	1.0E+06	**	3.5	32	37436.1	46.027	31.9581	29	52.8	30.1	41.2	65.0	30.1	0
120.4	34.6	20	28.347	44.783	31.806	3	0	200	1.0E+06	**	3.5	32	37522.7	44.7835	31.8057	29	52.6	29.9	41.2	64.8	29.9	0
122.5	37.5	20	30.399	41.038	32.906	3	0	200	1.0E+06	**	3.5	32	37796.5	41.0382	32.9056	29	52.0	29.4	41.2	64.2	29.4	0
159.7	22	20	56.026	20.680	77.169	3	0	200	1.0E+06	**	3.5	32	39582.8	20.6797	77.169	29	46.7	24.5	41.2	58.9	24.5	0
72.8	40.9	20	35.073	34.637	39.316	3	0	200	1.0E+06	**	3.5	32	38306.5	34.6373	39.3155	29	50.7	28.2	41.2	62.9	28.3	0
73.1	41.2	20	35.160	34.538	38.793	3	0	200	1.0E+06	**	3.5	32	38314.8	34.5383	38.7933	29	50.7	28.2	41.2	62.9	28.2	0
75.3	39.9	20	33.303	36.790	36.880	3	0	200	1.0E+06	**	3.5	32	38129.2	36.7899	36.8802	29	51.2	28.7	41.2	63.4	28.7	0
75.6	39.7	20	33.052	37.118	36.626	3	0	200	1.0E+06	**	3.5	32	38102.7	37.118	36.6257	29	51.2	28.7	41.2	63.4	28.7	0
79	35.1	20	29.272	43.003	35.094	3	0	200	1.0E+06	**	3.5	32	37650.5	43.0026	35.0937	29	52.3	29.7	41.2	64.5	29.7	0
80.2	27.2	20	25.792	50.771	39.728	3	0	200	1.0E+06	**	3.5	32	37125.3	50.7715	39.7278	29	53.4	30.6	41.2	65.6	30.7	0
80.3	26.9	20	25.674	51.097	39.868	3	0	200	1.0E+06	**	3.5	32	37105.1	51.0973	39.8683	29	53.4	30.7	41.2	65.6	30.7	0
84	39.8	20	30.596	40.715	25.530	3	0	200	1.0E+06	**	3.5	32	37821	40.715	25.5302	29	51.9	29.3	41.2	64.1	29.3	0

84.5	33.9	20	27.396	46.805	27.972	3	0	200	1.0E+06	**	3.5	32	37382.9	46.8051	27.9724	29	52.9	30.2	41.2	65.1	30.2	0
84.9	44.6	20	33.791	36.167	22.346	3	0	200	1.0E+06	**	3.5	32	38179.9	36.1674	22.3462	29	51.0	28.5	41.2	63.2	28.6	0
85.5	31.4	20	26.179	49.740	28.026	3	0	200	1.0E+06	**	3.5	32	37190.1	49.7399	28.0256	29	53.3	30.5	41.2	65.5	30.5	0
93.5	48.5	20	35.763	33.870	9.970	3	0	200	1.0E+06	**	3.5	32	38371	33.8698	9.96968	29	50.6	28.1	41.2	62.8	28.1	0
93.5	45.5	20	33.060	37.108	10.458	3	0	200	1.0E+06	**	3.5	32	38103.5	37.1081	10.458	29	51.2	28.7	41.2	63.4	28.7	0
93.7	32.5	20	25.575	51.373	13.410	3	0	200	1.0E+06	**	3.5	32	37088.2	51.3726	13.4101	29	53.5	30.7	41.2	65.7	30.7	0
95.9	36.2	20	27.024	47.657	8.593	3	0	200	1.0E+06	**	3.5	32	37325.7	47.6573	8.59307	29	53.0	30.3	41.2	65.2	30.3	0
97.3	37.6	20	27.645	46.256	6.050	3	0	200	1.0E+06	**	3.5	32	37420.3	46.2559	6.04999	29	52.8	30.1	41.2	65.0	30.1	0
97.5	32.8	20	25.473	51.664	6.442	3	0	200	1.0E+06	**	3.5	32	37070.4	51.6635	6.44181	29	53.5	30.7	41.2	65.7	30.8	0
97.8	32.7	20	25.423	51.807	5.908	3	0	200	1.0E+06	**	3.5	32	37061.7	51.8072	5.90842	29	53.5	30.8	41.2	65.7	30.8	0
105.9	37.4	20	27.603	46.348	8.034	3	0	200	1.0E+06	**	3.5	32	37414.1	46.3477	8.03414	29	52.8	30.1	41.2	65.0	30.1	0
106.1	32.9	20	25.586	51.342	9.331	3	0	200	1.0E+06	**	3.5	32	37090.1	51.3419	9.33075	29	53.5	30.7	41.2	65.7	30.7	0
106.2	32.1	20	25.280	52.222	9.718	3	0	200	1.0E+06	**	3.5	32	37036.7	52.2216	9.71818	29	53.6	30.8	41.2	65.8	30.8	0
106.3	39.2	20	28.589	44.300	8.350	3	0	200	1.0E+06	**	3.5	32	37557	44.3005	8.35006	29	52.5	29.8	41.2	64.7	29.9	0
106.5	48.4	20	35.466	34.196	7.337	3	0	200	1.0E+06	**	3.5	32	38343.5	34.196	7.33723	29	50.6	28.2	41.2	62.8	28.2	0
110.4	31.6	20	25.419	51.818	17.533	3	0	200	1.0E+06	**	3.5	32	37061	51.8182	17.5335	29	53.5	30.8	41.2	65.7	30.8	0
110.7	33.5	20	26.203	49.678	17.208	3	0	200	1.0E+06	**	3.5	32	37194.1	49.6781	17.2076	29	53.3	30.5	41.2	65.5	30.5	0
113.4	40.2	20	29.958	41.782	18.811	3	0	200	1.0E+06	**	3.5	32	37740.6	41.7821	18.8105	29	52.1	29.5	41.2	64.3	29.5	0
114.6	32.5	20	26.301	49.426	24.240	3	0	200	1.0E+06	**	3.5	32	37210.1	49.4263	24.2402	29	53.2	30.5	41.2	65.4	30.5	0
115.1	39.3	20	29.707	42.219	21.632	3	0	200	1.0E+06	**	3.5	32	37708.1	42.2193	21.632	29	52.2	29.5	41.2	64.4	29.6	0
115.3	36.2	20	28.069	45.353	23.344	3	0	200	1.0E+06	**	3.5	32	37482.8	45.3525	23.3443	29	52.7	30.0	41.2	64.9	30.0	0
117.2	32.8	20	26.866	48.030	28.205	3	0	200	1.0E+06	**	3.5	32	37300.9	48.0304	28.2054	29	53.0	30.3	41.2	65.2	30.3	0
117.3	33.1	20	27.011	47.688	28.168	3	0	200	1.0E+06	**	3.5	32	37323.7	47.6878	28.1677	29	53.0	30.3	41.2	65.2	30.3	0
118.2	35.1	20	28.089	45.312	28.296	3	0	200	1.0E+06	**	3.5	32	37485.7	45.3117	28.2956	29	52.6	30.0	41.2	64.8	30.0	0
118.2	34.4	20	27.762	46.002	28.719	3	0	200	1.0E+06	**	3.5	32	37437.8	46.0017	28.7188	29	52.8	30.1	41.2	65.0	30.1	0
118.2	33.8	20	27.492	46.592	29.094	3	0	200	1.0E+06	**	3.5	32	37397.4	46.5917	29.0938	29	52.8	30.1	41.2	65.0	30.2	0
118.3	33.9	20	27.557	46.448	29.181	3	0	200	1.0E+06	**	3.5	32	37407.2	46.4481	29.1806	29	52.8	30.1	41.2	65.0	30.2	0
118.4	34	20	27.622	46.305	29.267	3	0	200	1.0E+06	**	3.5	32	37417	46.3046	29.267	29	52.8	30.1	41.2	65.0	30.1	0
118.4	37.4	20	29.299	42.952	27.292	3	0	200	1.0E+06	**	3.5	32	37654.2	42.9523	27.2919	29	52.3	29.7	41.2	64.5	29.7	0
120.1	34.6	20	28.275	44.928	31.376	3	0	200	1.0E+06	**	3.5	32	37512.5	44.9284	31.3756	29	52.6	29.9	41.2	64.8	30.0	0
120.2	39.2	20	30.763	40.446	28.854	3	0	200	1.0E+06	**	3.5	32	37841.4	40.4463	28.854	29	51.9	29.3	41.2	64.1	29.3	0
121.2	37.4	20	29.982	41.741	31.206	3	0	200	1.0E+06	**	3.5	32	37743.6	41.7414	31.2061	29	52.1	29.5	41.2	64.3	29.5	0
122.3	47.5	20	37.985	31.626	27.871	3	0	200	1.0E+06	**	3.5	32	38563.8	31.6264	27.8706	29	50.0	27.6	41.2	62.2	27.6	0

CERTIFICATE OF SERVICE

I, Leslie Anne Byers, hereby certify that I have this 11th day of May, 1993, served a copy of the foregoing "Comments of American Mobile Satellite Corporation" by hand delivery to the following:

Mr. Norbert Schroeder
Program Manager, Spectrum Openness
National Telecommunications and
Information Administration
Room 4092, U.S. Department of Commerce
14th Street and Constitution Avenue, N.W.
Washington, D.C. 20230

Leslie Anne Byers

Leslie Anne Byers